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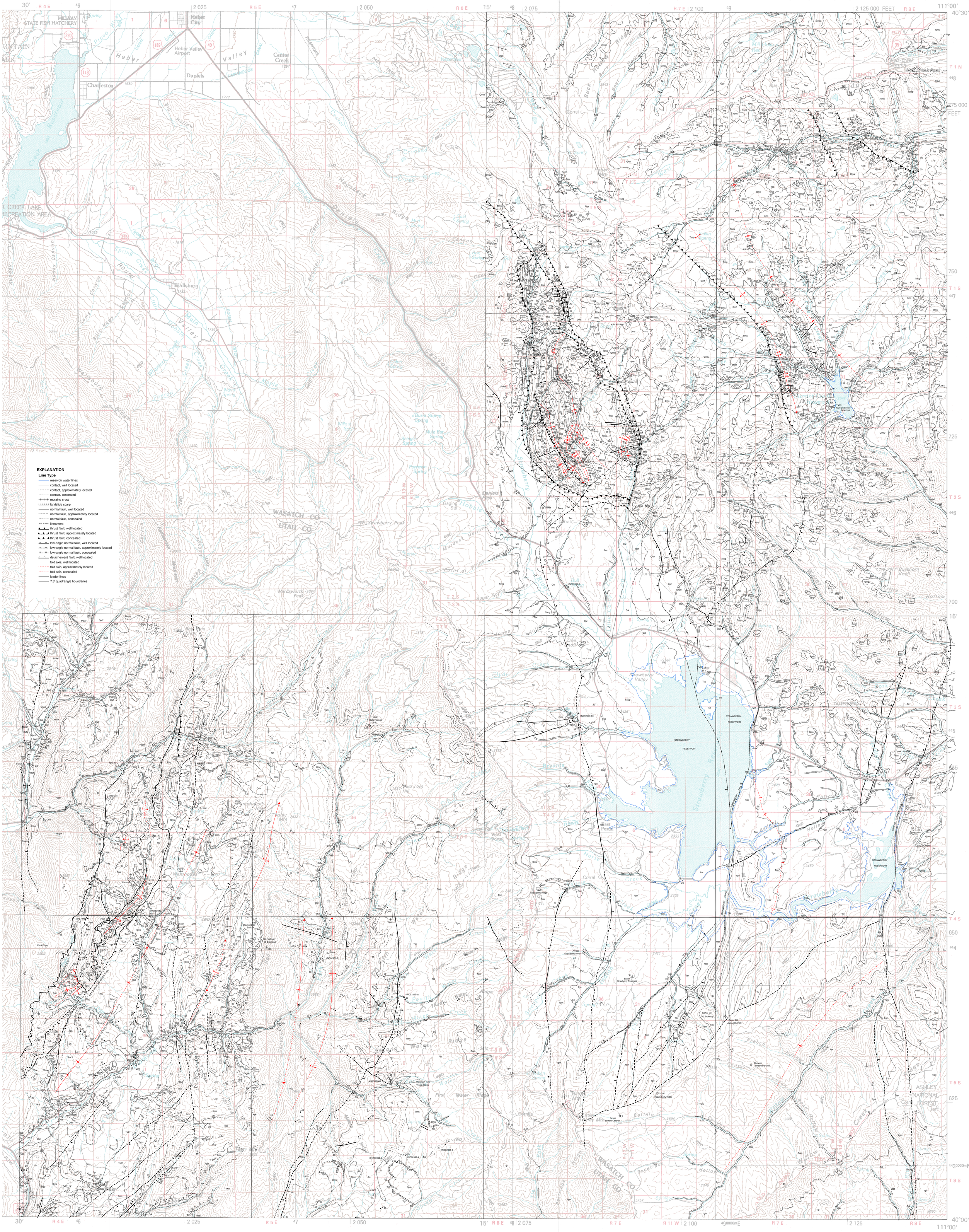
Open-File Report 418
Progress Report Geologic Map of the Provo 30' x 60' Quadrangle Utah



Progress Report Geologic Map of the East Part of the Provo 30' x 60' Quadrangle, Utah

(year 3 of a multiyear project) by Kurt N. Constenius and James C. Coogan

2003

PROGRESS REPORT GEOLOGIC MAP OF THE EAST PART OF THE PROVO 30' x 60' QUADRANGLE, UTAH

(year 3 of a multi-year project)

by

Kurt N. Constenius and James C. Coogan

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Map Unit Descriptions

Qh Human disturbance (Holocene) – Fill material used at Strawberry and Currant Creek dams.

Qa Alluvium, undivided (Quaternary) – Sand, silt, clay, and gravel in stream and alluvial-fan deposits; composition depends on source area; 0 to 20 feet (0-6 m) thick.

Qal Stream and floodplain alluvium (Holocene) -- Sand, silt, clay, and gravel in channels and floodplains; composition depends on source area; 0 to 20 feet (0-6 m) thick.

$Qat_{1,2}$ Stream terrace alluvium (Holocene and Pleistocene) --Sand, silt, clay, and gravel in terraces above floodplains; number suffixes apply to local drainages with multiple terrace levels with lowest (youngest) terraces labeled 1; 0 to 45 feet (0-14 m) thick.

Qaf, Qafy, Qafo
Alluvial-fan deposits (Holocene and Pleistocene) -- Mostly sand, silt, and gravel that is poorly stratified and poorly sorted; deposited mainly by debris flows at drainage mouths; Qafy are Holocene and deflect stream channels; Qafo are deeply incised by younger drainages; generally less than 40 feet (12 m) thick.

Qap Pediment-mantle deposits (Quaternary) -- Alluvial sand and gravel deposited on broad surfaces on top of Cretaceous bedrock above the mouths of tributaries to Currant Creek, north and northwest of Currant Creek Reservoir; 0 to 50 feet (0-15 m) thick.

Qac Alluvium and colluvium (Quaternary) -- Includes stream and fan alluvium, colluvium, and, locally, mass-movement deposits; 0 to 20 feet (0-6 m) thick.

Qc Colluvium (Quaternary) -- Includes slopewash and soil creep; composition depends on local bedrock; generally less than 20 feet (6 m) thick.

Qm Mass-movement deposits, undivided (Quaternary) -- Includes slides, slumps, and flows, as well as colluvium and talus; mapped on steep slopes where several mass-movement processes may contribute to deposit; composition depends on local sources; 0 to 40 feet (12 m) thick.

Qmc Mass movement and colluvial deposits, undivided (Quaternary) -- Includes landslide, slump, slopewash, and soil creep; mapped in areas of subdued morphology where separate mapping of mass movement and colluvial deposits is not possible; composition depends on local sources; 0 to 40 feet (12 m) thick.

Qmt Talus deposits (Holocene) -- Angular debris on and at the base of steep slopes; composed of Pennsylvanian quartzite in the upper Strawberry River drainage; 0 to 30 feet (0-9 m) thick.

Qmf Flow deposits (Holocene(?) and Upper Pleistocene(?)) – Large-scale earthflows deposited on gently inclined terraces between Right Fork and Left Fork of Currant Creek; exhibits hummocky internal morphology and distinct hummocky margins; formed where conglomerate of the Uinta Formation lies above Upper Cretaceous clay-rich bedrock; as much as 200 feet (60 m) thick.

Qms, Qmsy, Qmso, Qms1
Slides and slumps (Quaternary) -- Poorly sorted clay- to boulder-sized material derived from steep local source terrain; generally characterized by hummocky topography, head and internal scarps, and chaotic bedding in displaced bedrock; locally includes flow deposits; morphology becomes subdued with age; divided into younger (Holocene) and older deposits where possible (suffixes y and o, respectively); Qms1 are historical slides, slumps, and flows; thicknesses highly variable.

Qmg Mass-movement and glacial deposits, undivided (Holocene and Upper Pleistocene) -- Pinedale till and bedrock displaced in a lobate slide mass downslope from well-developed head scarp on the north side of Lake Creek drainage; up to 300 feet (91 m) thick.

Qgy Younger glacial deposits (Holocene and Upper Pleistocene) -- Non-stratified, poorly sorted clay, silt, sand, cobbles, and boulders deposited in the upper reaches of non-vegetated cirque basins; generally characterized by sharp non-vegetated moraines and very poor soil development; 0 to 50 feet (0-15 m) thick.

Qgp Glacial deposits, Pinedale age (Upper Pleistocene) -- Non-stratified, poorly sorted clay, silt, sand, gravel, cobbles, and boulders derived from headwall bedrock sources and deposited in broad, generally north-facing valleys and some steep-walled, south facing, high elevation cirques; includes outwash deposits; moraines, where present, show moderate to sharp morphology; till has weak soil development; 0-150 feet (46 m) thick.

Qgo Older glacial deposits (Pleistocene) -- Non-stratified, poorly sorted clay, silt, sand, gravel, cobbles, and boulders; has well-developed soil and subdued moraine morphology; locally includes older slides and slumps.

Tk Keetley Volcanics (Oligocene-Eocene) -- Volcanic breccia and conglomerate in upper part, interbedded volcanic conglomerate and minor light-gray tuffaceous sandstone in lower 300 feet (90 m); volcanic clasts are andesite to rhyodacite; conglomerate has light-orange and gray, coarse sandstone matrix and locally contains orthoquartzite, sandstone, and limestone boulders to pebbles; tuffaceous sandstone is light gray, coarse grained to pebbly, and trough cross-bedded; sample KNC92799-5 from Coop Creek quadrangle was Ar/Ar dated at 40.45$\pm$0.18 Ma (hornblende); 0 to more than 1,400 feet (0-427+ m) thick.

Tkt Keetley Volcanics, basal tuffaceous unit (Oligocene - Eocene) – Very light-gray to greenish-gray tuff and tuffaceous sandstone and pebbly sandstone; rarely exposed;

sample KNC92799-6 from Coop Creek quadrangle was Ar/Ar dated at 37.25±0.14 Ma (hornblende); 0 to about 200 feet (0-60 m) thick.

Tt Tibble Formation (Oligocene-Eocene?) -- Brick-red, red-brown and gray, cobble to boulder conglomerate; lithic clasts predominantly Pennsylvanian-Permian sandstone and quartzite, largest boulders about 2 m across; intercalated with variegated brick-red and gray mudstone, bentonitic mudstone, and poorly sorted sandstone; minor white to light-gray, tuffaceous sandstone and medium-gray, microcrystalline limestone; rare thin beds of light-gray tuff; mapped in graben in northwest part of Granger Mountain quadrangle; to the north and west, the Tibble overlies with angular unconformity, and is locally in fault contact with pre-Tertiary hanging wall rocks of the Charleston-Nebo thrust sheet; 0 to 2,500 feet (0-762 m) thick regionally.

Tvc Volcaniclastic rocks of Strawberry Valley (Oligocene - Eocene?) – Upper part is tan to orange and gray conglomerate and coarse-grained sandstone; conglomerate contains quartzite cobbles to small boulders with sandstone, limestone, and volcanic clasts locally present. Lower part is light-gray, boulder to cobble conglomerate with quartzite and andesite to rhyodacite clasts in a coarse to pebbly sandstone matrix; interbedded with light-gray, coarse-grained, cross-bedded, tuffaceous sandstone. Correlative northward to Keetley Volcanics and southward to Moroni Formation; sample KNC92899-2 from Coop Creek quadrangle was Ar/Ar dated at 37.73±0.28 Ma (biotite); at least 1,500 feet (457 m) thick; top not exposed.

Tm Moroni Formation (Oligocene-Eocene) - Very light-gray, gray and white, tuffaceous and pumiceous sandstone and tuff interbedded with lesser conglomerate, pumice, welded tuff and limestone; conglomerate clasts vary from pebbles and cobbles to small boulders (~20 inches [0.5 m]); sedimentary clasts from Pennsylvanian-Permian Oquirrh Formation, Permian Diamond Creek Sandstone and Park City Formation, and Cambrian Tintic Quartzite; igneous rocks predominantly gray to very dark-gray, reddish brown-weathering andesite-dacite porphyry; tuffs and tuffaceous sandstones poorly exposed, conglomerate bed in lower part of unit is ledge forming and about 65 feet (20 m) thick; formation rests unconformably on Tuc?; top removed by erosion, 0 to an estimated 1,800 feet (~550 m) thick; mapped as Tibble Formation by Young (1976), but not like Tibble; sample KNC711945 from Billies Mountain quadrangle was Ar/Ar dated at 34.48±0.085 Ma (single crystal sanidine).

Tuc? Uinta and Colton(?) Formations, undivided -- Used in Billies Mountain quadrangle; lithologically like Uinta Formation; about 350 feet (105 m) of strata at base of unit are probably time equivalent of Colton Formation, because Green River strata pinch out in Two Tom Hill and Granger Mountain quadrangles. The basal strata are not like typical Green River or Colton Formations.

Tu Uinta Formation, main body (Eocene) -- Includes light-gray, tan, and red, medium- to thick-bedded, lenticular-bedded, pebbly sandstone; brick-red, reddish-brown, variegated,

very thick- to thin-bedded mudstone, commonly with floating sand grains; red-brown, tan, and gray conglomerate with sandstone to mudstone matrix; and dark-gray to yellowish- and purplish-gray marlstone of probable pedogenic origin; interfingers northward with underlying Tucg, and westward with overlying Tucg, but conglomerates are not otherwise distinguishable; at least 2,000 feet (610 m) exposed.

Tucg Uinta Formation, conglomerate (Eocene) -- Gray, red, and red-brown, thick- to very thick-bedded conglomerate, commonly stained red by weathering of interbedded, thin, red-brown mudstone; clasts vary in size from pebbles and cobbles to large boulders 3 to 10 feet (1-3 m) in diameter; quartzite clasts derived from Pennsylvanian-Permian Oquirrh Formation predominate, with clasts derived from Precambrian Uinta Mountain Group, Cambrian Tintic Quartzite, Pennsylvanian Weber Formation, Permian Park City Formation, Triassic Thaynes Formation, and Jurassic Twin Creek Limestone locally present; sandstone is subordinate to conglomerate and occurs as intercalated lenses of coarse- to very coarse-grained, brick-red to red-brown sandstone; mudstone is brick red to red brown and forms thin partings between ledges of conglomerate; interfingers with the main body of the Uinta Formation eastward and southward over short distances; up to 1,500 feet (457 m) thick.

Tgu Green River Formation, upper member (Eocene) -- Sandstone, siltstone, mudstone, marlstone and minor oil shale. Sandstone is light gray, light-brown weathering, calcareous, and medium to thick bedded; some beds are trough cross-stratified and fine to medium grained, grading to siltstone; occasionally coarse-grained to conglomeratic. Marlstone is dark gray, weathering to light tan, light gray or gray, thin to thick bedded, and microcrystalline. Mudstone is predominantly greenish gray to dark gray and poorly exposed. Oil shale is rare, grayish brown to dark brown, and thinly laminated to fissile. Sandstone and marlstone form steep slopes and cliffs, with thin benches along oil shale and mudstone horizons. More than 400 feet (120 m) thick at Island Mountain where the base of the unit is not exposed.

Tgm Green River Formation, middle member (Eocene) -- Lower part is dominantly dark brown, light-bluish-gray weathering, fissile to platy, thinly laminated oil shale and marlstone; upper part is mostly greenish-gray and gray mudstone, gray siltstone, and tan, fine- to medium-grained sandstone; distinctive small steel-blue to dark-bluish-gray concretions throughout; at least 2,200 feet (670 m) thick.

Tgl Green River Formation, lower member (Eocene) – Greenish-gray, fissile to blocky shale and mudstone as very thick beds separated by thinly laminated, gray marlstone; also contains gray-green, waxy textured claystone and thin-bedded, brown-weathering sandstone that is locally micaceous; sandstone contains rare vertebrate fossils as lags (gar scales, turtle and crocodile plates); oil shale is common near base; at least 1,200 feet (366 m) thick.

Tc Colton Formation (Eocene) -- Medium- to coarse-grained, light-gray, light-brown

weathering, calcareous sandstone in thin to thick beds; interbedded with medium-gray, microcrystalline limestone, and red-brown, gray and gray-green mudstone; top of formation in Rays Valley 7.5' quadrangle is at the top of an extremely fossiliferous sandstone bed containing *Unionidae* bivalves, gastropods, and vertebrate fossils (gar scales, crocodile teeth, crocodile and turtle plates and bones); about 170 feet (52) m thick.

Tf Flagstaff Limestone (Eocene) -- Medium-gray, very thick-bedded, microcrystalline limestone; weathers white and light gray; hard and brittle; forms cliffs; interbedded with less-resistant, variegated brick-red, purplish-gray, maroon, red-brown, yellow and gray marlstone and calcareous mudstone; light-gray, thin- to medium-bedded, medium- to coarse-grained sandstone increases in abundance upsection; about 280 feet (85 m) thick.

Tn North Horn Formation, upper member (Paleocene) – Brick-red, thick- to very thick-bedded mudstone, siltstone, and sandstone; interbedded with very thick-bedded, medium-gray weathering, dense, microcrystalline limestone interbeds containing fossil gastropods; conglomerate locally present as thick, lenticular, channel-fill deposits containing pebbles to rare boulders of Pennsylvanian-Permian Oquirrh Formation; about 200 feet (61 m) thick.

Tnq North Horn Formation, quartzite conglomerate member (Paleocene) – Light-gray, thick- to very thick-bedded, cobble to boulder (up to about 1 m across) conglomerate with dominantly well-rounded, gray and tan quartzite clasts from the Oquirrh Formation; intercalated with light-gray, yellow-tan-weathering, and brick-red, medium- to coarse-grained sandstone; limonitic staining common; upper contact conformable with Tn; lower contact in profound angular unconformity with Permian rocks; present in Granger Mtn. area; 0 to 250 feet (0-76 m) thick.

TKn North Horn Formation, lower member (Maastrichtian-Paleocene) -- Light- to medium-gray or brick-red or red-brown conglomerate, commonly discolored by red-colored slopewash from thin, interbedded, red mudstone; medium- to very thick-bedded; cobble- to boulder-sized clasts of Pennsylvanian-Permian Oquirrh Formation sandstone, quartzite and limestone predominate; at least 1,800 feet (550 m) thick.

TKnc North Horn and Currant Creek Formations, undivided -- Conglomerate, sandstone, siltstone and minor shale of TKn and TKc; mapped together in area of poor exposure on east side of upper Co-op Creek drainage.

TKc Currant Creek Formation (Upper Cretaceous and Paleocene) -- Includes gray- to tan-weathering, thick-bedded, boulder to cobble conglomerate, dominated by well-rounded, quartzite clasts from Oquirrh Formation; gray, yellowish-gray, and minor red, thick-bedded, coarse-grained sandstone and pebble conglomerate; and gray, very light-gray and variegated siltstone; about 4,800 feet (1,460 m) thick.

Kpc Price River Formation and Castlegate Sandstone (Upper Cretaceous) - Light-gray, thick- to very thick-bedded, cobble to boulder conglomerate, dominated by well-rounded, gray and tan, quartzite clasts; largest boulders exceed 10 feet (3 m) across; minor intercalated sandstone; conglomerate contains light silvery-gray sandstone matrix; matrix also characterized by white, smooth to earthy textured, clay blebs; lithic clasts >99% Pennsylvanian-Permian Oquirrh Formation quartzite, quartzite clasts derived from Proterozoic Mutual Formation and Cambrian Tintic Quartzite present in trace amounts; overlain with angular unconformity by TKn; underlain by Kcm with angular unconformity; thickness ranges from 0 to 2,000 feet (0 to 610 m).

Kmv Mesaverde Formation (Upper Cretaceous) -- Light-gray, white, and tan, thick-bedded, cross-bedded, coarse-grained sandstone, gray siltstone, and dark-brownish-gray, carbonaceous shale and coal; up to 5,200 feet (1,585 m) thick.

Km Mancos Shale (Upper Cretaceous) -- Dark-gray, bentonitic shale with minor gray limestone and gray, fine-grained sandstone; very poorly exposed; about 1,700 feet (520 m) thick.

Kf Frontier Formation (Upper Cretaceous) -- Light-gray, white, and tan, thick-bedded, medium-grained sandstone interbedded with dark-gray siltstone, shale, dark-brownish-gray, carbonaceous shale and minor coal in upper part; contains an oyster coquina marker bed in the lower 50 feet (15 m); extensively burrowed in the middle; about 700 feet (213 m) thick.

Kmm Mancos Shale, Mowry Shale Tongue (Lower Cretaceous) -- Dark-gray, platy to blocky, fissile, siliceous shale in lower part, with abundant teleost fish scales. Upper part contains massive-weathering, greenish-gray claystone; about 90 feet (27 m) thick.

Kd Dakota Formation (Lower Cretaceous) -- Sandstone, white to tan, very thick-bedded, cross-bedded, with extensive quartz veins; interbedded with gray and variegated siltstone; thickens northward from about 200 to 400 feet (61-122 m) thick.

KJcm Cedar Mountain (Lower Cretaceous) and Morrison (Upper Jurassic) Formations, undivided -- Pinkish-gray, quartz- and chert-pebble conglomerate and pebbly sandstone in thick, fining-upward, trough-cross-stratified beds; interbedded with greenish-gray and light-red siltstone and medium-grained, pinkish-gray sandstone; base not exposed; up to 2,500 feet (762 m) thick in southeastern Heber Mountain 7.5' quadrangle.

Kcm Cedar Mountain Formation (Lower Cretaceous) – Mapped separately in southwest part of map area. Variegated greenish gray, red-brown, and lavender mudstone, interbedded with gray, red, and buff, coarse- to fine-grained sandstone and siltstone; minor nodular limestone and conglomerate; 465 feet (142 m) thick.

Jsv Summerville Formation (Upper Jurassic) - Red-orange mudstone, siltstone, and

sandstone; only mapped in southwest part of map area; 395 feet (120 m) thick.

Js Stump Formation (Middle Jurassic) -- Light-gray, medium-bedded, calcareous sandstone in lower part; gray to green-gray, thick-bedded, ridge-forming, bioclastic limestone and sandy limestone in upper part; about 250 feet (76 m) thick.

Jce Curtis and Entrada Formations, undivided (Middle Jurassic) – Only mapped in southwest part of map area; lateral equivalent of Stump and Preuss. Curtis - Greenish gray, sandy shale, mudstone, and sandstone, with minor dark-red-brown sandstone; about 400 feet (122 m) thick. Entrada - Dark-red, red-brown, and purplish red-brown, with minor light-gray and light-brown, thin- to medium-bedded sandstone and siltstone; about 1,000 feet (300 m) thick.

Jp Preuss Formation (Middle Jurassic) – Red, brownish-red, purplish red, and minor light-gray, thin- to medium-bedded sandstone and siltstone; poorly exposed; about 750 feet (229 m) thick.

Ja Arapien Shale (Middle Jurassic) - Light gray-green and light-gray shale interbedded with light-gray, tan-weathering, ripple cross-laminated, calcareous siltstone and sandstone; minor interbeds of red shale, light yellow-gray sandstone, and gray-green to brown, micritic limestone; thickness about 560 feet (175 m); only mapped in southwest part of map area, equivalent to unit Jtgl.

Jtu Twin Creek Formation, upper members (Middle Jurassic) – Mapped in Co-op Creek and Heber Mountain 7.5' quadrangles where upper Twin Creek is structurally attenuated; divided into units Jtgl and Jtw elsewhere; top not exposed; estimated undeformed thickness is about 650 feet (198 m) from regional relationships.

Jtgl Twin Creek Formation, Giraffe Creek and Leeds Creek Members (Middle Jurassic) – Thinly interbedded, light-gray to light-greenish-gray, soft, shaley limestone and platy weathering, light-gray to tannish-gray, fine-grained calcareous sandstone; sandstone increases upward; a 15-foot-thick (5 m) gypsum bed lies in the middle of the unit; about 500 feet (152 m) thick.

Jtwl Twin Creek Formation, Watton Canyon, Boundary Ridge, Rich, Sliderock, and Gypsum Spring Members (Middle Jurassic) – Only mapped in southwest part of map area where upper two members are indistinct and are mapped as the Arapien Shale.

Jtw Twin Creek Formation, Watton Canyon Member (Middle Jurassic) – Dark gray, medium- to thick-bedded, lime micrite to wackestone with oolites and pelecypod fragments; resistant ridge former; micrites display a characteristic spaced, bedding-normal fracture; about 120 feet (37 m) thick.

Jtl Twin Creek Formation, lower members (Middle Jurassic) -- Mapped in Co-op Creek and

Heber Mountain 7.5' quadrangles where lower Twin Creek is structurally attenuated; divided into units Jtb and Jtrsg elsewhere; estimated undeformed thickness is about 230 feet (70 m) from regional relationships.

Jtb Twin Creek Formation, Boundary Ridge Member (Middle Jurassic) – Red to purplish-red shale and siltstone, and minor, gray siltstone; recessive and poorly exposed; about 65 feet (20 m) thick.

Jtrsg Twin Creek Formation, Rich, Sliderock and Gypsum Spring Members (Middle Jurassic) – Light-gray, soft, shaley limestone in upper part; dark-gray, thick-bedded, bioclastic limestone in middle, and thin (5-foot-thick [1.5 m]) purple shale at base; about 160 feet (49 m) thick.

Jn Navajo Sandstone (Lower Jurassic) – Reddish-orange, orange, and pink, massive-weathering, cross-bedded, moderately cemented to friable, noncalcareous, well-rounded, fine- to medium-grained sandstone, with common frosted grains; Nugget of some previous workers; about 1,260 to 1,450 feet (185-442 m) thick

TRa Ankareh Formation (Upper and Lower(?) Triassic) – Dull-red, reddish-brown and purple, thin-bedded mudstone, siltstone, and medium- to thin-bedded, fine-grained sandstone; siltstone is locally micaceous; green reduction spots common; in Co-op Creek 7.5' quadrangle, the brecciated, light-red sandstone near the base of unit is probably the conglomerate member, and the lower Ankareh member is included in unit TRat (see below); at least 300 feet (91 m) thick. Baker (1947) cited a total thickness of 1,485 to 1,530 feet (453 to 466 m).

TRau Ankareh Formation, upper member (Upper Triassic) – Red, purplish-red, and reddish-gray, thin-bedded mudstone, siltstone, and fine-grained sandstone; about 350 (107 m) feet thick.

TRas Ankareh Formation, conglomerate member (Upper Triassic) – Gray to white, very thick-bedded, cross-bedded, coarse-grained sandstone and pebble conglomerate; about 40 feet (12 m) thick; equivalent to the Gartra.

TRal Ankareh Formation, lower member (Lower Triassic) – Red and purple siltstone and shale, and purplish-gray, calcareous siltstone; thin bedded throughout; poorly exposed; about 800 feet (244 m) thick.

TRat Lower Ankareh Formation and Upper Thaynes Formation, undivided (Lower Triassic) – Greenish-gray and very light-gray, calcareous sandstone with green clay intraclasts in upper part; white, thinly laminated, well-indurated, calcareous sandstone and micaceous sandstone in lower part; unit contains rocks that are transitional between typical lower Ankareh and upper Thaynes lithologies; about 350 feet (107 m) thick.

TRt Thaynes Formation, undivided (Lower Triassic) -- Greenish-gray to brownish-gray, thin-bedded, silty limestone and fine-grained, calcareous sandstone; only used in northeast corner of map area and Billies Mountain quadrangle, subdivided elsewhere; top not exposed. Neighbor (1959) reported a dip-corrected thickness of 1,450 feet (442 m), based on four wells on the Diamond Fork anticline.

TRtu Thaynes Formation, upper member (Lower Triassic) – Dark-gray, bioclastic, lime grainstone; weathers medium blue gray; forms two prominent ridges separated by thin-bedded, dark-gray, silty limestone; about 300 feet (91 m) thick.

TRtl Thaynes Formation, lower member (Lower Triassic) – Mainly dark-brownish-red, thin- to medium-bedded, calcareous siltstone with rare zones of dark-gray, blue-gray weathering, bioclastic grainstone resembling unit TRtu in lower part; typically about 1,000 feet (305 m) thick, though structurally thickened in Heber Mountain 7.5' quadrangle.

TRw Woodside Formation (Lower Triassic) – Dark-red to red-brown shale and siltstone; poorly exposed; forms strike valleys; 420 to 600 feet (128-183 m) thick; 548 feet (167 m) thick in the Amoco Cottonwood Canyon well, Rays Valley quadrangle.

Ppf Park City Formation, Franson Member (Permian) – Dolomite; light tannish gray; weathers very light tannish gray to white; very thick bedded; silty to sandy; with small, quartz-filled vugs and light-gray, white, and tan chert as nodules and stringers; commonly highly fractured to brecciated; about 650 feet (200 m) thick in Willow Creek area of Co-op Creek 7.5' quadrangle; 660 feet (201 m) thick in the Amoco Cottonwood Canyon well, Rays Valley quadrangle.

Ppm Phosphoria Formation, Meade Peak Phosphatic Member (Permian) – Dark-gray to black, fissile, siliceous, occasionally oolitic shale and thin-bedded, medium-gray siltstone with brown and gray laminations; poorly exposed, forms benches and swales with siliceous shale and siltstone chips as float; about 225 feet (70 m) thick in Willow Creek area of Co-op Creek 7.5' quadrangle; 267 feet (81 m) thick in the Amoco Cottonwood Canyon well, Rays Valley quadrangle.

Ppg Park City Formation, Grandeur Member (Permian) – Dominantly dolostone in upper two-thirds that is medium to dark gray, weathers very light gray, is very thick bedded, and is fine to medium crystalline, with dispersed, white, chert nodules; lower part is medium-gray, gray-weathering, shelly, dolomitic lime wackestone; both parts thick bedded, with dark-gray, 0.4- to 0.8-inch-thick (1-2 cm) chert layers; 685 feet (210 m) thick in the Willow Creek area of Co-op Creek 7.5' quadrangle; 835 feet (255 m) thick in the Amoco Cottonwood Canyon well, Rays Valley quadrangle. Baker (1947) reported thickness of 883 feet (269 m).

Pdc Diamond Creek Sandstone/Formation (Permian) – Very light-gray, white, and yellowish-brown, very thick-bedded, fine-grained, friable sandstone, with thin-bedded, light-gray, calcareous sandstone interbeds; poorly exposed, forms swale between Grandeur and Kirkman carbonate ribs; in Little Diamond Creek area, it is ledge-forming, buff and salmon colored, cross-bedded, medium- to coarse-grained sandstone with lesser thin-bedded, sandy limestone and dolomite; 165 feet (50 m) thick in the Willow Creek area of Co-op Creek 7.5' quadrangle; 1,265 feet (386 m) thick in the Amoco Cottonwood Canyon well, Rays Valley quadrangle. Baker (1947) reported thickness of 835 feet (255 m).

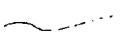
Pk Kirkman Limestone (Permian) – Gray to very dark-gray and dark-brownish-gray, thick- to medium-bedded, nonlaminated to thinly laminated, dolomitic limestone; intraformational breccia makes up upper two-thirds of Kirkman and consists of darker gray beds of rotated, thinly laminated, limestone clasts, and lighter gray beds of nonlaminated, dolomitic limestone; contains rare, thin beds of red-weathering, gray, slabby weathering, sandy limestone; strong fetid odor when broken; thickness varies from 97 to 375 feet (30-115 m) on the west side of the Strawberry River valley; 334 feet (102 m) thick in the Amoco Cottonwood Canyon well, Rays Valley quadrangle.

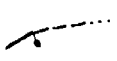
Pogm Oquirrh Formation, Granger Mountain Member (Permian) -- Gray, limy, silty, tan-weathering sandstone, with abundant worm-like trail markings; interbedded with minor gray, red, and buff quartzite, light-gray sandstone, and thin to thick beds of gray limestone; 8,200 to 10,255 feet (2,500-3,126 m) thick.

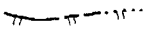
IPowr Oquirrh Formation, Wallsburg Ridge Member (Pennsylvanian) – Quartzite and sandstone; thick-bedded, light-gray to yellowish-brown, feldspathic (orthoquartzite) to siliceous, fine- to medium-grained; quartzite strata have common conchoidal fracture; locally thinly laminated to cross-bedded; includes rare, silty and sandy, gray limestone interbeds; about 3,700 and 6,500 feet (1,130 and 1,980 m) thick in Center Creek and Wallsburg Ridge quadrangles, respectively, on northwest margin of map area.

Map Symbols


reservoir high-water shoreline (blue)


contact, dashed where approximately located, dotted where concealed

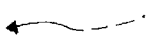

normal fault, dashed where approximately located, dotted where concealed, ball and bar on hanging wall

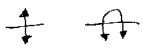

low-angle normal fault, dashed where approximately located, dotted where concealed, paired hachures on hanging wall

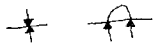

detachment fault, open teeth on hanging wall


thrust fault, dashed where approximately located, dotted where concealed, solid teeth on hanging wall

lineament

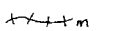

fold axes (red), dashed where approximately located, dotted where concealed, arrow indicates plunge, upright on left, overturned on right


anticline


syncline


monocline, antiformal hinge on left, synformal hinge on right

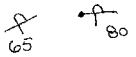
mass-movement headscarp


moraine crest

strike and dip of bedding

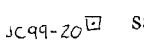
upright, top certain in middle, from previous work* on right

vertical



overturned


horizontal



sample location with number

11

~ springs

H- hot to warm
C-cold
S-sulphur, hydrogen sulfide?
M-methane bubbles

Mountain Fuel Thistle Dome — boreholes, with name

References Cited and Previous Work

Baker, A.A., 1947, Stratigraphy of the Wasatch Mountains in the vicinity of Provo, Utah: U.S. Geological Survey Oil and Gas Preliminary Chart OC-30, scale 1:6,000.

*Baker, A.A., 1976, Geologic map of the west half of the Strawberry Valley [30'] quadrangle, Utah: U.S. Geological Survey Miscellaneous Investigations Series Map I-931, scale 1:63,360.

Neighbor, Frank, 1959, Geology of the Diamond Fork anticline, *in* Williams, N.C., editor, Guidebook to the geology of the Wasatch and Uinta Mountains transition area: Intermountain Association of Petroleum Geologists, Tenth Annual Field Conference, p. 178-181.

*Young, G.E., 1976, Geology of Billies Mountain quadrangle, Utah County, Utah: Brigham Young University Geology Studies, v. 23, part 1, p. 205-280, scale 1:31,680.

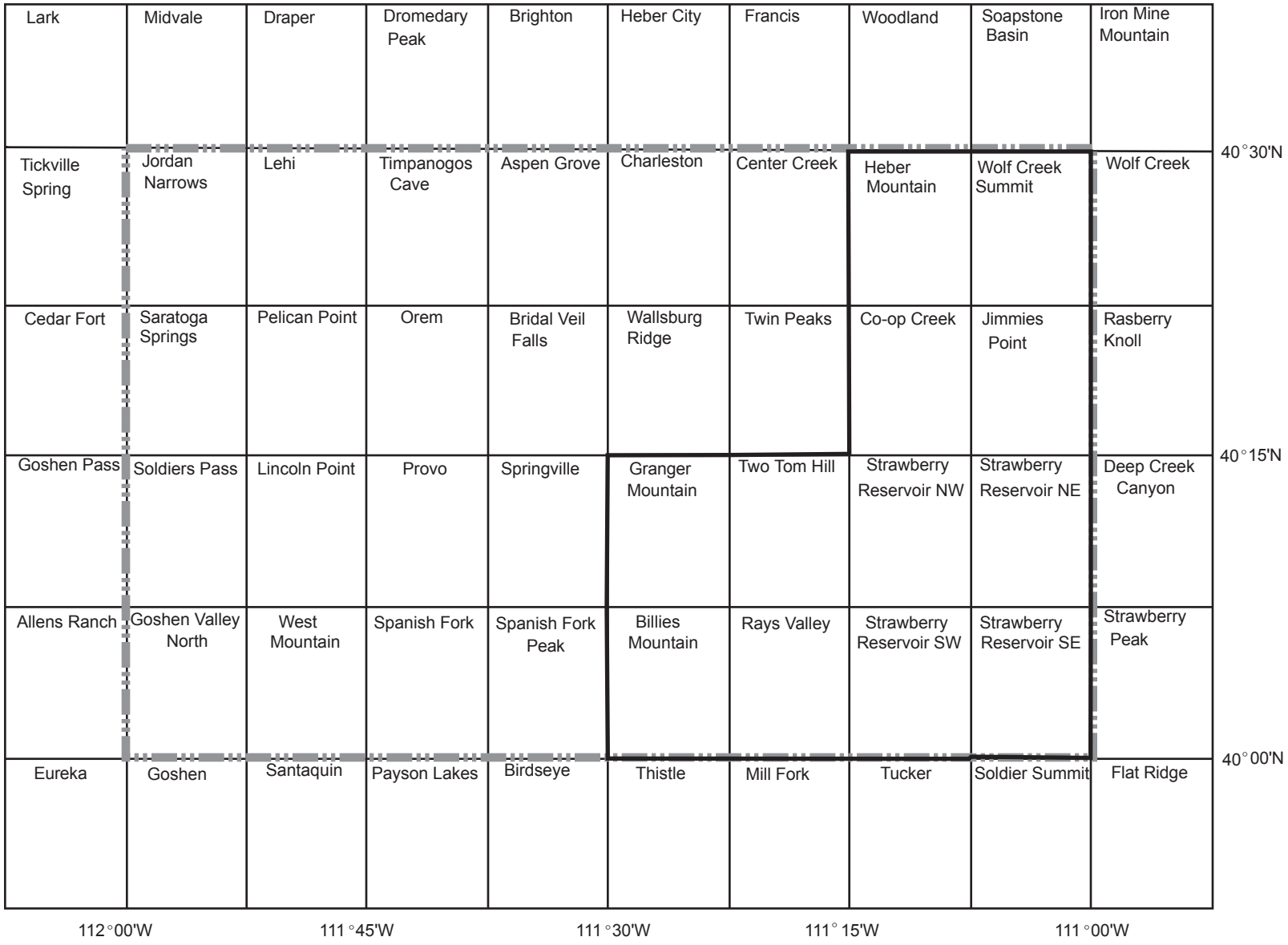
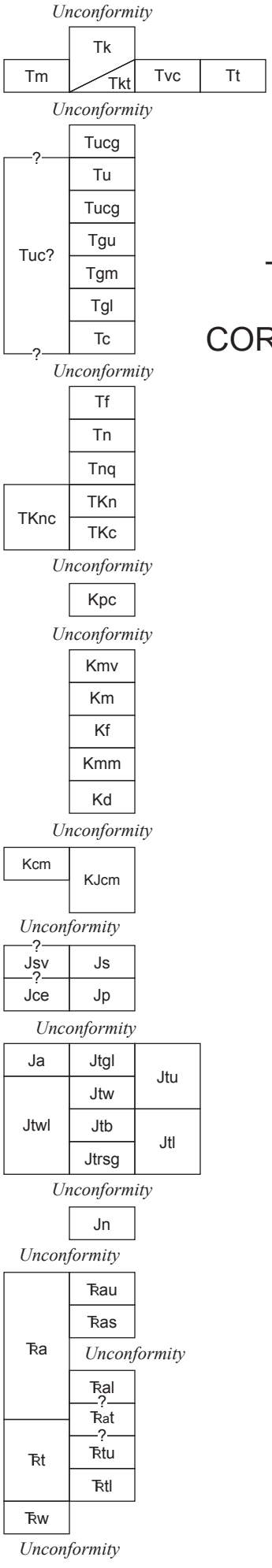
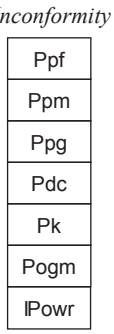


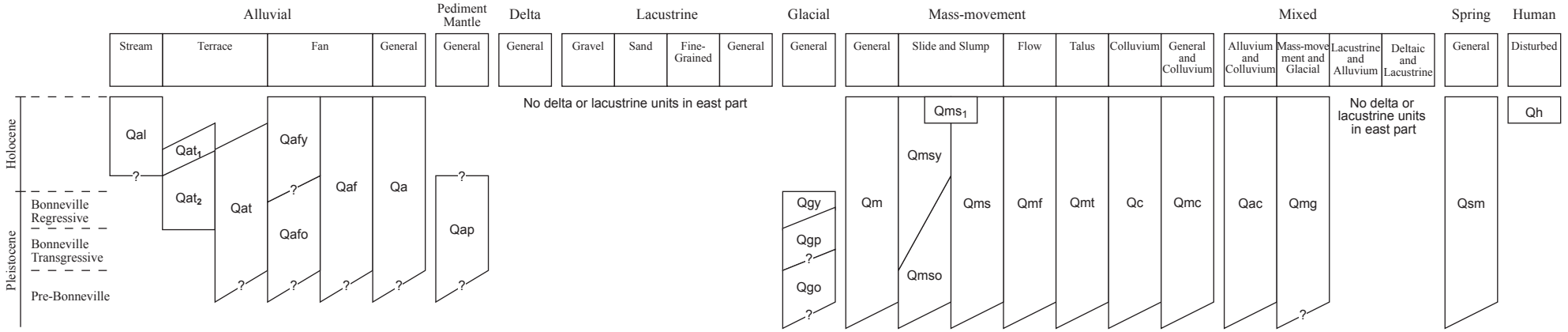
Figure 1. Provo 30' x 60' quadrangle, Utah index to geologic mapping, year 3.

TERTIARY AND MESOZOIC CORRELATION CHART



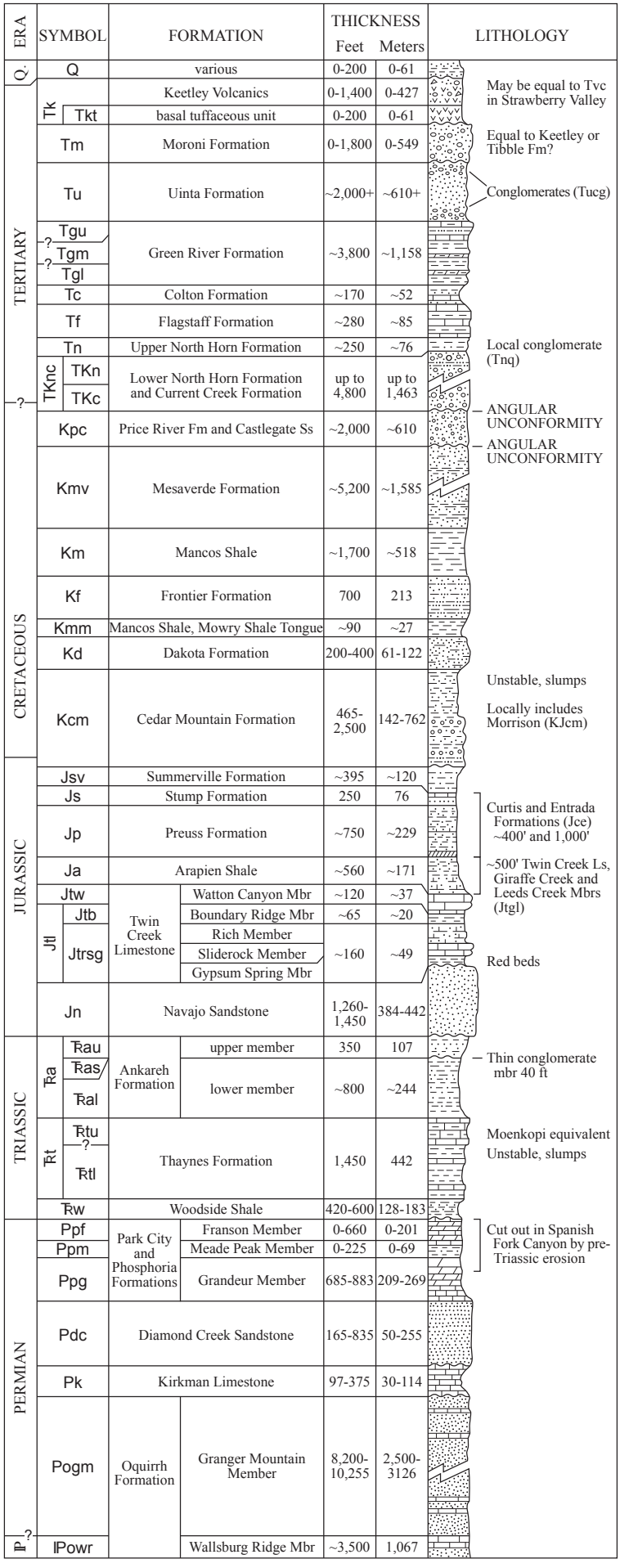
PALEOZOIC CORRELATION CHART





PROVO 30x60'
QUATERNARY

PROVO 30' X 60'


ERA
SYMBOL
FORMATION
THICKNESS
Feet
Meters
LITHOLOGY
Q.
TERTIARY
CRETACEOUS
JURASSIC
TRIASSIC
PERMIAN
P
Q
various
0-200
0-61
Keetley Volcanics
0-1,400
0-427
May be equal to Tvc in Strawberry Valley
Tk
Tkt
basal tuffaceous unit
0-200
0-61
Tm
Moroni Formation
0-1,800
0-549
Equal to Keetley or Tibble Fm?
Tu
Uinta Formation
~2,000+
~610+
Conglomerates (Tucg)
Tgu
Tgm
Tgl
Green River Formation
~3,800
~1,158
Tc
Colton Formation
~170
~52
Tf
Flagstaff Formation
~280
~85
Tn
Upper North Horn Formation
~250
~76
Local conglomerate (Tnq)
TKnc
TKn
TKc
Lower North Horn Formation and Current Creek Formation
up to 4,800
up to 1,463
ANGULAR UNCONFORMITY
Kpc
Price River Fm and Castlegate Ss
~2,000
~610
ANGULAR UNCONFORMITY
Kmv
Mesaverde Formation
~5,200
~1,585
Km
Mancos Shale
~1,700
~518
Kf
Frontier Formation
700
213
Kmm
Mancos Shale, Mowry Shale Tongue
~90
~27
Kd
Dakota Formation
200-400
61-122
Kcm
Cedar Mountain Formation
465-2,500
142-762
Unstable, slumps
Locally includes Morrison (KJcm)
Jsv
Summerville Formation
~395
~120
Js
Stump Formation
250
76
Jp
Preuss Formation
~750
~229
Curtis and Entrada Formations (Jce) ~400' and 1,000'
Ja
Arapien Shale
~560
~171
~500' Twin Creek Ls, Giraffe Creek and Leeds Creek Mbrs (Jtgl)
Jtw
Watton Canyon Mbr
~120
~37
Jtl
Jtb
Boundary Ridge Mbr
~65
~20
Jtrsg
Twin Creek Limestone
Rich Member
Sliderock Member
Gypsum Spring Mbr
~160
~49
Red beds
Jn
Navajo Sandstone
1,260-1,450
384-442
Trau
Tra
Tras
Tral
Ankareh Formation
upper member
lower member
350
107
~800
~244
Thin conglomerate mbr 40 ft
Trtu
Trt
Trtl
Thaynes Formation
1,450
442
Moenkopi equivalent
Unstable, slumps
Trw
Woodside Shale
420-600
128-183
Ppf
Ppm
Ppg
Park City and Phosphoria Formations
Franson Member
Meade Peak Member
Grandeur Member
0-660
0-225
685-883
0-201
0-69
209-269
Cut out in Spanish Fork Canyon by pre-Triassic erosion
Pdc
Diamond Creek Sandstone
165-835
50-255
Pk
Kirkman Limestone
97-375
30-114
Pogm
Oquirrh Formation
Granger Mountain Member
8,200-10,255
2,500-3126
lPowr
Wallsburg Ridge Mbr
~3,500
1,067